is there, for instance, in declaring that my "definition for temperature"[1] is erroneous without an accompanying proof showing that Newton's law of radiation is also erroneous? As this particular matter stands, Dr. Reid has simply made a dogmatic assertion, for if Newton's law is true (and I claim to have demonstrated that it is true) it follows as a theoretical necessity that *absolute temperature is a direct measure of the intensity of ether vibration.* If Stefan's law, or any other law except Newton's, can be demonstrated to be true, then, and then only, will scientists be justified in summarily condemning my conclusions.

J. M. Schaeberle

Ann Arbor, Mich.,
January 4, 1909

American Scientific Productivity

It is well that we should be reminded by Professor Nichols in his presidential address before the American Association (Science, January 1, 1909) and by Professor Pickering in his articles in *The Popular Science Monthly* (October, 1908, and January, 1909) that the scientific work accomplished in this country is not commensurate with its population and its wealth, and that Professor Willcox (Science, January 29, 1909) should reinforce this fact from the awards of the Nobel prizes.

But while we can not too strongly emphasize the circumstance that we are not doing all that we should for the advancement of science and that this is partly due to the fact that the scientific career is not made sufficiently attractive to obtain and retain the best men, nor sufficiently free to enable them to do their best work, it yet seems that the situation is by no means discouraging. The articles mentioned measure our scientific productivity by the eminent men we have. In so far as this is an adequate method, it tends to measure our activity a generation ago; for men do not usually obtain international recognition until long after the work for which it is given has been accomplished.

Professor Pickering finds that of the 87 scientific men who are members of at least two foreign academies only six are Americans. Each of the two eminent American men of science who is a member of the largest number of academies is in his seventy-third year. It is a striking fact that of the six distinguished Americans, three are astronomers; and astronomy is the only science in which thirty years ago the facilities for research work in this country were equal to those of the leading European nations. Of the remaining three, two have not been engaged in teaching, and the third has been practically freed from teaching for his research work. We may have, in accordance with Professor Pickering's data, but six scientific men as distinguished as 17 in Prussia, 13 in England and 12 in France, but this would represent the relative scientific activity of the country at the time when our universities were only beginning to develop and when research work under the government was only beginning.

The Nobel prizes have, contrary to the instructions of the founder, been, as a rule, awarded to eminent men for work done in the past; and the fact that of twenty-four prizes in the sciences only one has come to America does not discredit our present scientific research. If the provision of Nobel's will had been followed and the prize had been given to the person "rendering the greatest service to humanity," by "having made the most important discovery or invention in the department of physical science," the first two awards should probably have been to Mr. Bell and Mr. Edison.

It is a curious fact that the three subjects in which the Nobel prizes are awarded—physical science, chemistry and medicine—are those in which we are particularly weak. These are the sciences in which the applications are the most direct, and it looks as if those competent to advance these sciences had been carried into practical work. This is contrary to my preconceptions, for I should suppose that when there are large opportunities for practical work, there should also be advances in pure science. Perhaps it is only individual eminence that is here lacking, and we are in fact contributing our share to

[1] Science, January 1, 1909, p. 29.

The choir invisible
Whose music is the gladness of the world.

We seem to do better in the natural sciences. In geology, zoology, botany, anthropology and psychology, there is probably more research work published here than in any other country except the German empire and the amount of research work published is the most tangible, and perhaps the most exact, measure of scientific activity. I have found that in the *Zeitschrift für Psychologie* there have been more articles in experimental psychology reviewed (selected as the more important articles) from America than from the German-speaking nations combined, and more than ten times as many as from Great Britain. We have also, according to the criterion of membership in foreign academies, the most eminent living psychologist.

The statement made by Professor Nichols and endorsed by Professor Willcox that "the men who have laid the foundations upon which civilization is built have nearly all been teachers and professors" appears to be more correct for Germany than for England. Darwin did not teach, and not one of the five scientific members of the Order of Merit—Hooker, Huggins, Lister, Rayleigh and Wallace—is a teacher. It is a remarkable fact that while Germany has excelled in the quantity of research work accomplished since the development of its universities, England has produced the greatest leaders. The elementary teaching required in our collegiate universities not only absorbs time and energy, but also tends to develop a superficial omniscience and a dogmatic attitude unfavorable to investigation. If we add to this the clerical, administrative and missionary work, which the university president crowds on the university professor, and the distracting need of earning enough money to support his family, there is perhaps reason to wonder that he accomplishes as much research work as he does accomplish.

Fortunately there has been within thirty years a great increase in this country in the number of positions permitting scientific work, and in the opportunities which these positions offer for research work. Many of our universities have admirable laboratories, and there is certainly a strong sentiment in favor of permitting the professors to use them. We are gradually obtaining university laboratories analogous to the astronomical observatories, where professors will only do so much teaching as is favorable to their investigations. At the same time there has been a notable development of scientific work outside the universities, under the national government, under states and municipalities, in technological work, and recently in the establishment of research institutions such as the Carnegie Institution of Washington and the Rockefeller Institute for Medical Research. The material foundation is already adequate and will be rapidly enlarged. What we need is more men with the ability and spirit which research work demands.

J. MCKEEN CATTELL

SCIENTIFIC BOOKS

Qualitative Analyse vom Standpunkte der Ionenlehre. Von Dr. WILHELM BÖTTGER, Privatdozent und Oberassistent am Phys.-Chem. Institut der Universität Leipzig. Zweite, Umgearbeitete und Stark Erweitete Auflage. Leipzig, Wilhelm Engelmann. 1908.

The first edition of this book was published in 1902. An English translation by Smeaton appeared in 1906, a book of 300 pages. This second German edition is a stately volume of 524 pages; it contains nearly double as much matter as its predecessor and is quite different in arrangement.

The fundamental general and ionic theory is in a division by itself, forming the first 116 pages of the book, and is illustrated by simple but ingenious and instructive experiments, thirty-five in number. These experiments alone would give the book permanent value, but it is worthy of study throughout.

In the chapter on systematic analysis, for example, a method is given, familiar in detail but new in application, for separating the cations of group III.; after treatment of the sulphides with dilute HCl, and filtering, the filtrate containing Al, Cr, Fe, Mn, Zn and